

**FINAL REPORT  
SEPTEMBER 2004**

**REPORT NO. 04-16**



**44" x 40" METAL PALLET WITH METAL  
ADAPTERS, CARTRIDGE, 25MM, PA125 METAL BOXES,  
MIL-STD-1660 FIRST ARTICLE TESTS**

Prepared for:

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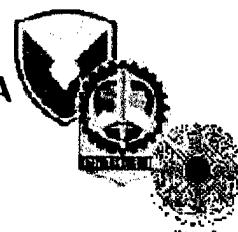
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**SEPTEMBER 2004**

**44" x 40" METAL PALLET WITH METAL ADAPTERS  
CARTRIDGE, 25MM, PA125 METAL BOXES,  
MIL-STD-1660 FIRST ARTICLE TESTS**

**ABSTRACT**

The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SJMAC-DEV) conducted First Article Tests in accordance with MIL-STD-1660, "Design Criteria for Ammunition Unit Loads" on the 44" x 40" Metal Pallet with Metal Adapters, Cartridge 25MM, PA125 Metal Boxes manufactured by Choctaw Manufacturing and Development Corporation (CMDC), from Hugo, Oklahoma. Six sample test units were tested. The test units were loaded with a unit load of 2,565 lbs each. The tests accomplished on the test units were the stacking, repetitive shock, edgewise-rotational drop, incline-impact, sling compatibility, forklifting, and disassembly tests.

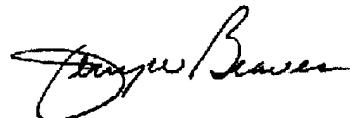
Test Units #1, #2 and #3 sustained minor damage on the welds between the skids and the struts during testing. Test Unit #1 also had a middle strap weld fail on the intermediate assembly. Test Unit #2 sustained additional minor damage when the stiffener on the top assembly had a weld failure. All damage was deemed minor in nature and not considered a cause for failure. While loading Test Unit #5, it was discovered that the intermediate adapter had a stiffener aligned in the wrong position and the last box could not be loaded. Corrective action was initiated by the manufacturer to rework the adapter, and the testing was completed satisfactorily. As a result of its performance during testing, the 44" x 40" Metal Pallet with Metal Adapters, Cartridge, 25MM, PA125 Metal Boxes manufactured by Choctaw Manufacturing and Development Corporation (CMDC), from Hugo, Oklahoma is recommended for use by the United States Army.

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Chief, Validation Engineering Division

**U.S. ARMY DEFENSE AMMUNITION CENTER**

**VALIDATION ENGINEERING DIVISION  
MCALESTER, OK 74501-9053**

**REPORT NO. 04-16**

**44" x 40" METAL PALLET WITH METAL ADAPTERS  
CARTRIDGE, 25MM, PA125 METAL BOXES,  
MIL-STD-1660 FIRST ARTICLE TESTS**

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## **PART 1 – INTRODUCTION**

**A. BACKGROUND**. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SJMPC-DEV) conducted First Article Tests in accordance with MIL-STD-1660, "Design Criteria for Ammunition Unit Loads" on the 44" x 40" Metal Pallet with Metal Adapters, Cartridge, 25MM, PA125 Metal Boxes manufactured by Choctaw Manufacturing and Development Corporation (CMDC), from Hugo, OK. Six test units were tested. The sample test units were loaded with a unit load of 2,565 lbs each. The tests accomplished on Test Units #1, #2, and #3 were the stacking, repetitive shock, edgewise-rotational drop, incline-impact, sling compatibility, forklifting, and disassembly tests. Tests accomplished on Test Units #4, #5, and #6 consisted of only the stacking test IAW MIL-A-70788, Military Spec, Adapter, Metal and Wood Pallet. The unitization procedures were provided by DAC, Transportation Engineering Division (SJMPC-DET).

**B. AUTHORITY**. This test was conducted IAW mission responsibilities delegated by the U.S. Army Joint Munitions Command (JMC), Rock Island, IL. Reference is made to the following:

1. AR 740-1, 15 June 2001, Storage and Supply Activity Operation
2. OSC-R, 10-23, Mission and Major Functions of the U.S. Army Defense Ammunition Center (DAC) 21 Nov 2000.

**C. OBJECTIVE**. The objective of the tests was to determine if the 44" x 40" Metal Pallet with Metal Adapters, Cartridge, 25MM, PA125 Metal Boxes met the MIL-STD-1660 test requirements prior to the acceptance of the unitization procedures by the U.S. Army.

**D. CONCLUSION**. As a result of its performance, the 44" x 40" Metal Pallet with Metal Adapters manufactured by Choctaw Manufacturing and Development Corporation (CMDC), from Hugo, OK is recommended for use by the United States Army.

## PART 2 - ATTENDEES

**DATE PERFORMED:** Test Unit #1- 9-11 August 2004  
Test Unit #2- 9-11 August 2004  
Test Unit #3- 9-11 August 2004  
Test Unit #4- 12 August 2004  
Test Unit #5- 13 August 2004  
Test Unit #6- 12 August 2004

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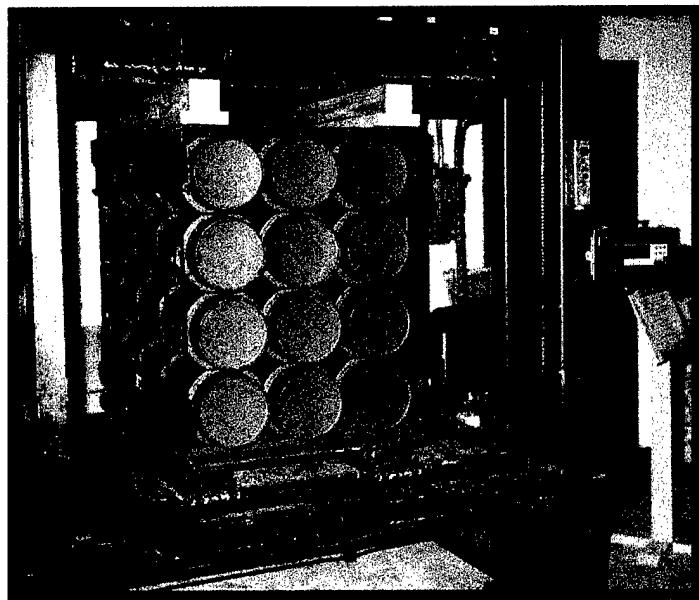
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ARDEC  
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Rock Island, IL 61299-7300

## **PART 3 - TEST PROCEDURES**

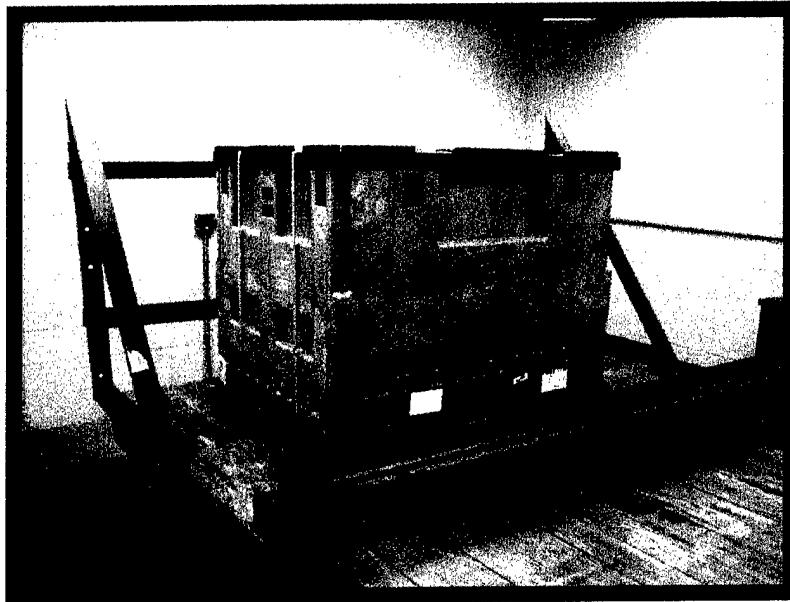
The test procedures outlined in this section were extracted from the MIL-STD-1660, "Design Criteria for Ammunition Unit Loads," 8 April 1977. This standard identifies steps that a unitized load must undergo if it is to be considered acceptable. The seven tests normally conducted on the test specimen are summarized below.

**A. STACKING TEST.** The specimen will be tested to simulate a stack of identical unit loads stacked 16 feet high, for a period of one hour. This stacking load will be simulated by subjecting the unit load to a compression weight equal to an equivalent 16-foot stacking height. Photo 1 below shows an example of a unit load in the compression tester.



**Photo 1. Example of Compression Tester.  
(2.75-inch Hydra 70, PA151 Rocket Pallet in the compression tester.)**

**B. REPETITIVE SHOCK TEST.** The repetitive shock test is conducted IAW Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen will be placed on (not fastened to) the platform. With the load in one position, the platform will be vibrated at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of approximately 3 cycles-per-second. The frequency will be steadily increased until the package leaves the platform. The resonant frequency is achieved when a 1/16-inch-thick feeler gage momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle. Midway into the testing period, the specimen will be rotated 90 degrees, and the test continued for the duration. Unless failure occurred, the total time of vibration will be three hours. Photo 2 shows an example of the repetitive shock test.

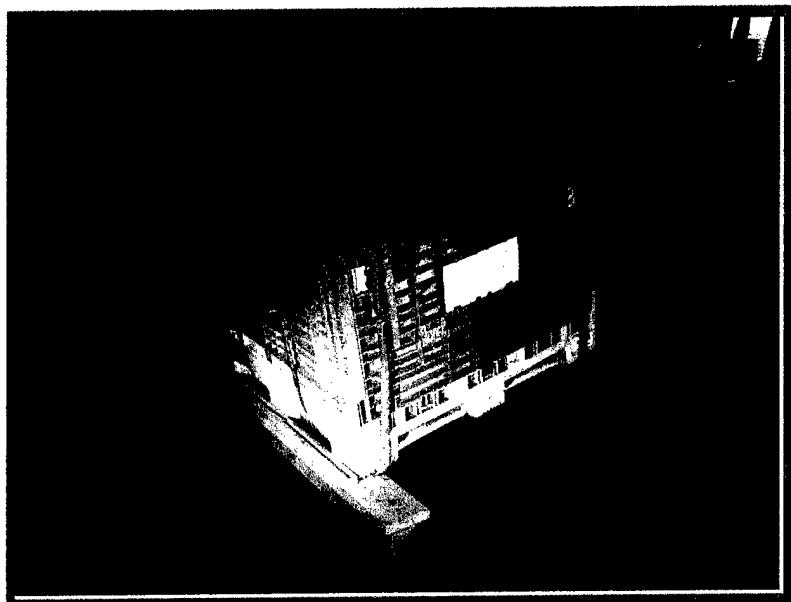


**Photo 2. Example of the Repetitive Shock Test.  
(Plastic Gemini Pallet Box)**

**C. EDGEWISE ROTATIONAL DROP TEST.** This test is conducted using the procedures of Method 5008, Federal Standard 101. The procedure for the edgewise rotational drop test is as follows: The specimen will be placed on its

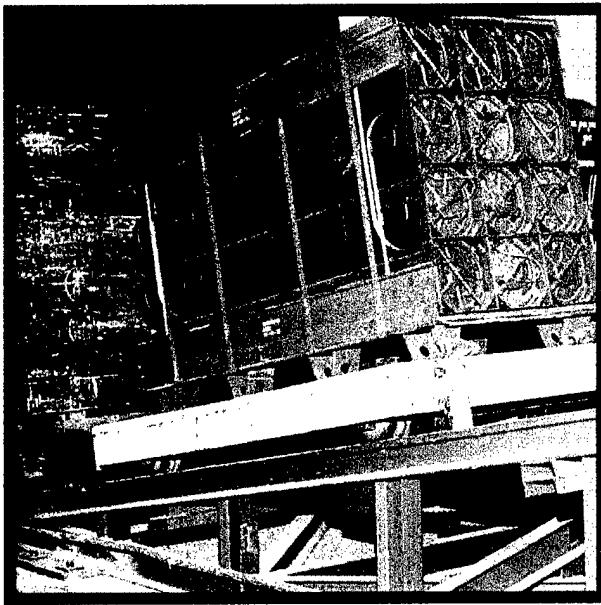
skids with one end of the pallet supported on a beam 6 inches high. The height of the beam will be increased as necessary to ensure that there is no support for the skids between the ends of the specimen when dropping takes place, but was not high enough to cause the specimen to slide on the supports when the dropped end is raised for the drop. The unsupported end of the specimen is then raised and allowed to fall freely to the concrete, pavement, or similar unyielding surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection conforms to the following tabulation:

GROSS WEIGHT (WITHIN RANGE LIMITS) (Pounds)	DIMENSIONS OF ANY EDGE, HEIGHT OR WIDTH (WITHIN RANGE LIMITS) (Inches)	HEIGHT OF DROPS ON EDGES	
		Level A (Inches)	Level B (Inches)
150-250	60-66	36	27
250-400	66-72	32	24
400-600	72-80	28	21
600-1,000	80-95	24	18
1,000-1,500	95-114	20	16
1,500-2,000	114-144	17	14
2,000-3,000	Above 145- No limited	15	12
Above – 3,000		12	9



**Photo 3. Example of Edgewise Rotational Drop Test  
(Plastic XYTEC 4845 Pallet Box)**

D. **INCLINE-IMPACT TEST.** This test is conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the incline-impact test is as follows: The specimen is placed on the carriage with the surface or edge to be impacted projecting at least 2 inches beyond the front end of the carriage. The carriage will be brought to a predetermined position on the incline and released. If it were desired to concentrate the impact on any particular position on the container, a 4- x 4-inch timber may be attached to the bumper in the desired position before the test. The carriage struck no part of the timber. The position of the container on the carriage and the sequence in which surfaces and edges were subjected to impacts may be at the option of the testing activity and dependent upon the objective of the test. When the test is to determine satisfactory requirements for a container or pack, and, unless otherwise specified, the specimen will be subjected to one impact on each surface that has each dimension less than 9.5 feet. Unless otherwise specified, the velocity at the time of the impact was 7 feet-per-second. Photo 4 shows an example of this test.



**Photo 4. Example of the Incline-Impact Test.  
(2.75-Inch, Hydra 70, PA151 Rocket Pallet on incline-impact tester.)**

**E. FORKLIFTING TESTS.** The specimen shall be lifted clear of the ground by a forklift from the end of the specimen and transported on the forks in the level or back-tilt position across a hard pavement for a distance of not less than 100 feet. The forklift will pass over the forklift hazard course as outlined in MIL-STD-1660. The hazard course will consist of parallel pairs of 1-inch boards spaced 54 inches apart and will be laid flatwise on the pavement across the path of the forklift. The first pair will be placed securely across the forklift's path and centered 30 feet from the starting point; the second pair will be laid 60 feet from the starting point at an angle of approximately 60 degrees to the path so the first wheel strikes first; and the third pair will be laid 90 feet from the starting point approximately 75 degrees to the path so the right wheel strikes first. The forklift will pass over the forklift hazard course 2 times in approximately 23 seconds, and then be brought to a stop. The load shall be observed for deflection and damage. The specimen will be rotated 90 degrees and the load lifted from the side and the above steps repeated.

**F. SLING COMPATIBILITY TEST.** The specimen utilizing special design or non-standard pallets will be lifted, swung, lowered and otherwise handled as necessary, using slings of the types normally used for handling the unit loads under consideration. Slings will be easily attached and removed. Danger of slippage or disengagement when load is suspended will be cause for rejection of the specimen.

**G. DISASSEMBLY TEST.** Following all rough handling tests the specimen may be squared up within 2 inches of its original shape and on a flat level surface. The strapping will then be cut and removed from the palletized load. Assembly of the load will be such that it retains its unity upon removal of the strapping.

## **PART 4 - TEST EQUIPMENT**

### **A. COMPRESSION TESTER.**

1. Nomenclature	Compression Table
2. Manufacturer:	Ormond Manufacturing
3. Platform:	60- by 60-inches
4. Compression Limit:	50,000 pounds
5. Tension Limit:	50,000 pounds

### **B. TRANSPORTATION (REPETITIVE SHOCK) SIMULATOR.**

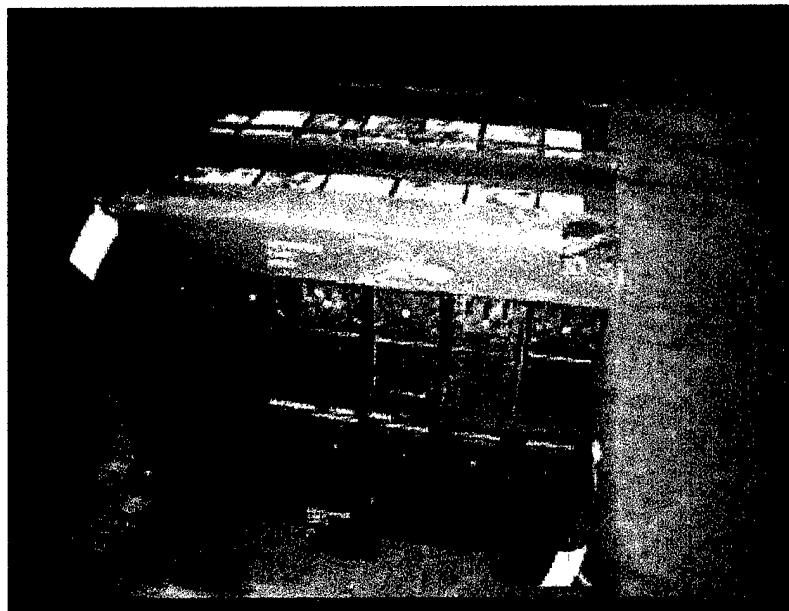
1. Nomenclature	Repetitive Shock Simulator
2. Manufacturer:	Gaynes Laboratory
3. Capacity:	6,000-pound payload
4. Displacement:	1/2-inch amplitude
5. Speed:	50 to 400 RPM
5. Platform:	5- by 8-foot

### **C. INCLINED PLANE.**

1. Nomenclature	Incline Plane Impact Tester
2. Manufacturer:	Conbur Incline
3. Type:	Impact Tester
4. Grade:	10 percent incline
5. Length:	12-foot

## **PART 5 - TEST RESULTS**

**A. CONTAINER DATA.** The sample test units were inertly loaded to the specified design weight. Special care was taken to ensure that each individual interior ammunition container had the proper amount of weight in order to achieve a realistic pallet center of gravity (CG). Once properly prepared, the test unit was tested using MIL-STD-1660, "Design Criteria for Ammunition Unit Loads," requirements. Photo 5 depicts the test unit loaded.



**Photo 5. Loaded Test Unit.**

### **TEST UNIT #1:**

Test Date:	9-11 August 2004	<u>Container inertly loaded with:</u>
Weight:	2,565 pounds	42 PA125 Metal Boxes loaded to
Length:	44-13/16 inches	55 pounds each with sand,
Width:	40-3/4 inches	gravel and scrap metal
Height:	33-5/8 inches	

**TEST UNIT #2:**

Test Date: 9-11 August 2004      Container inertly loaded with:  
Weight: 2,565 pounds  
Length: 44-13/16 inches  
Width: 40-3/4 inches  
42 PA125 Metal Boxes loaded to  
55 pounds each with sand, gravel  
and scrap metal

**TEST UNIT #3:**

Test Date: 9-11 August 2004      Container inertly loaded with:  
Weight: 2,565 pounds  
Length: 44-13/16 inches  
Width: 40-3/4 inches  
Height: 33-5/8 inches  
42 PA125 Metal Boxes loaded to  
55 pounds each with sand, gravel  
and scrap metal

**TEST UNIT #4:**

Test Date: 12 August 2004      Container inertly loaded with:  
Weight: 2,565 pounds  
Length: 44-13/16 inches  
Width: 40-3/4 inches  
Height: 33-5/8 inches  
42 PA125 Metal Boxes loaded to  
55 pounds each with sand, gravel  
and scrap metal

**TEST UNIT #5:**

Test Date: 13 August 2004      Container inertly loaded with:  
Weight: 2,565 pounds  
Length: 44-13/16 inches  
Width: 40-3/4 inches  
Height: 33-5/8 inches  
42 PA125 Metal Boxes loaded to  
55 pounds each with sand, gravel  
and scrap metal

**TEST UNIT #6:**

Test Date: 12 August 2004  
Weight: 2,565 pounds  
Length: 44-13/16 inches  
Width: 40-3/4 inches  
Height: 33-5/8 inches

Container inertly loaded with:  
42 PA125 Metal Boxes loaded to  
55 pounds each with sand, gravel  
and scrap metal

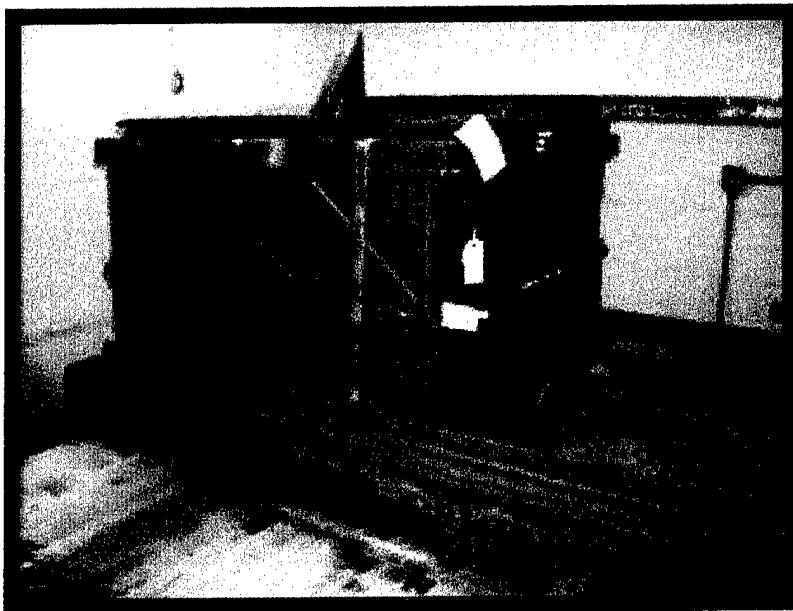
**B. TEST RESULTS of TEST UNIT #1:**

**1. STACKING TEST.** Test Unit #1 was compressed with a load force of 12,825 pounds for 60 minutes on 9 August 2004. There was no damage noted to the test unit as a result of this test. (See Photo 6 below).



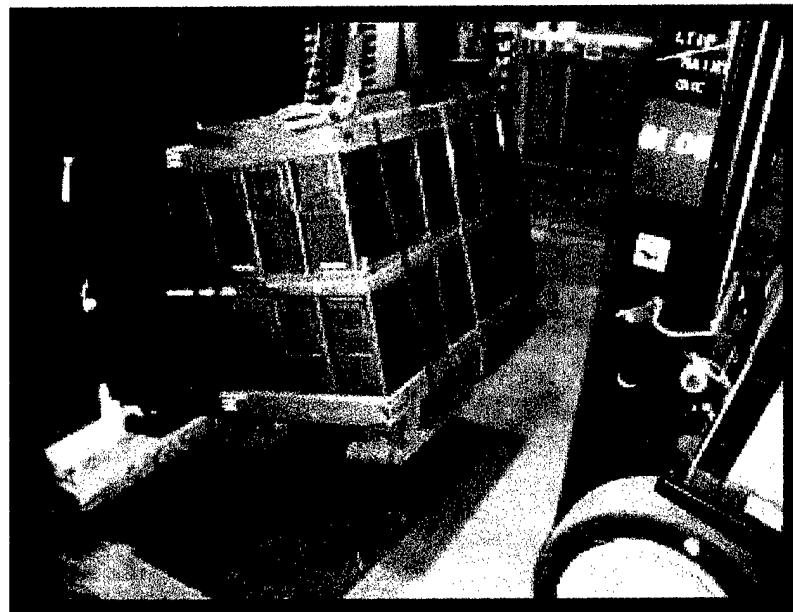
**Photo 6. Test Setup for Compression Testing.**

**2. REPETITIVE SHOCK TEST.** Test Unit #1 was vibrated 90 minutes at 205 RPM in the longitudinal orientation and 90 minutes at 220 RPM in the lateral orientation on 9 August 2004. Minor damage was noted on the welds between the struts and skids and the struts and the bottom of the pallet deck. No significant damage was noted during this test. (See Photo 7).

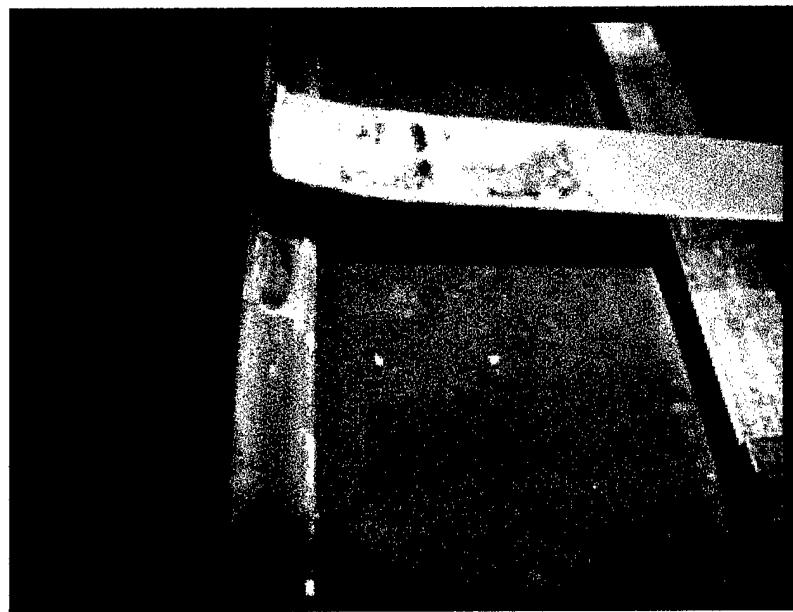


**Photo 7. Test Setup for Repetitive Shock Tests.**

3. **EDGEWISE ROTATIONAL DROP TEST.** Test Unit #1 was edgewise rotationally dropped from a height of 15 inches on both longitudinal sides and both lateral sides. It was noted that a weld had failed on the center brace (DAC Drawing ACV00141) on the intermediate assembly. The damage was deemed to be minor and the testing continued. See Photo 8 for the test setup for the drop tests. Photo 9 shows the failed intermediate assembly weld that was discovered during the disassembly of the test unit.

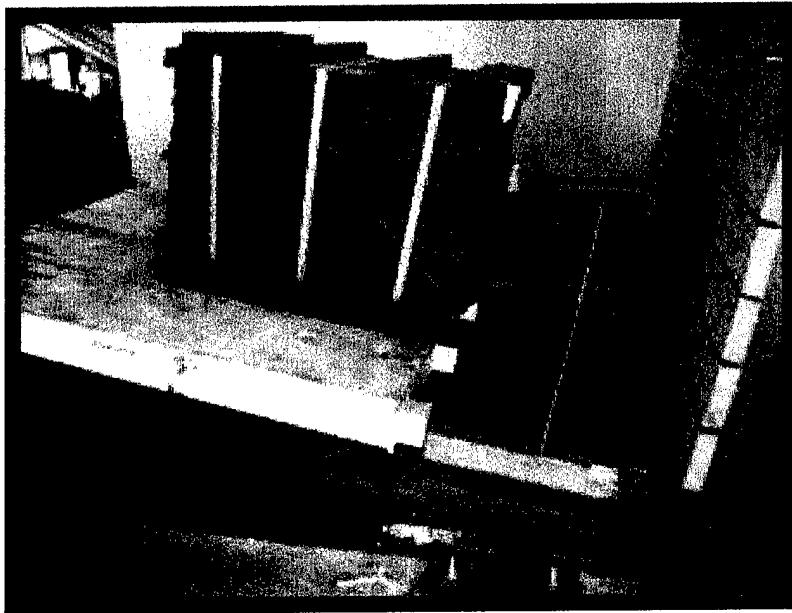


**Photo 8. Test Setup for Edgewise Rotational Drop Testing.**



**Photo 9. Weld Failure on Intermediate Assembly.**

**4. INCLINE-IMPACT TEST.** Test Unit #1 was incline-impacted on all four sides with the pallet impacting the stationary wall from a distance of 8 feet. No additional problems were encountered. See Photo 10 for test setup for incline-impact testing.



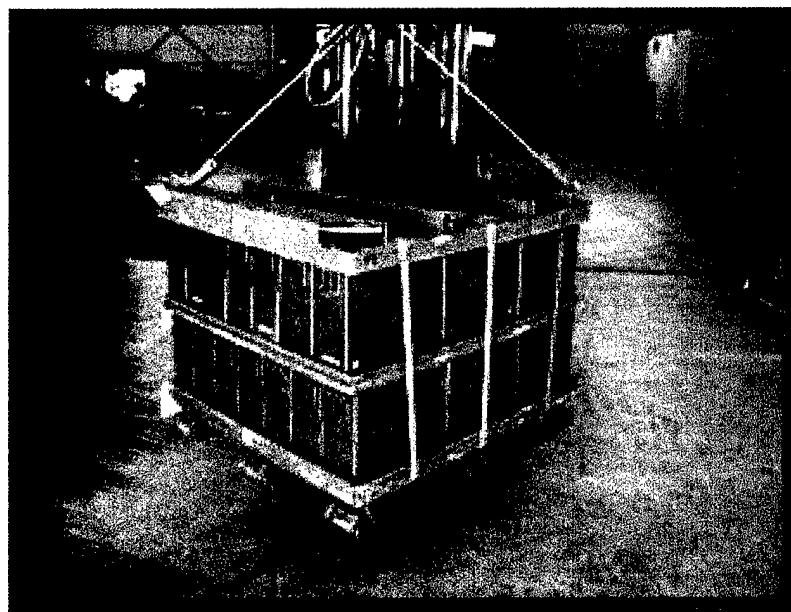
**Photo 10. Test Setup for Incline-Impact Testing.**

5. **FORKLIFTING TEST.** Test Unit #1 was lifted from the end of the pallet on the forks of the forklift truck and carried over the hazard course two times with no damage or instability noted. The test unit was lifted from the opposite end of the pallet and the above steps accomplished with no problems encountered. (See Photo 11 for the test setup).



**Photo 11. Test Setup for Forklifting Testing.**

**6. SLING COMPATIBILITY TEST.** Test Unit #1 was sling compatibility tested by slinging the container with lifting cables through the lifting rings on the top assembly. No problems were encountered during the lifts. (See Photo 12 for the test setup).



**Photo 12. Test Setup for Sling Compatibility Testing.**

7. **DISASSEMBLY TEST**. During the disassembly of Test Unit #1 no additional problems were noted.

8. **CONCLUSION**. Test Unit #1 passed all required tests.

**C. TEST RESULTS of TEST UNIT #2:**

1. **STACKING TEST**. Test Unit #2 was compressed with a load force of 12,825 pounds for 60 minutes on 9 August 2004. No damage was noted as a result of this test.

2. **REPETITIVE SHOCK TEST**. Test Unit #2 was vibrated 90 minutes at 205 RPM in the longitudinal orientation and 220 RPM in the lateral orientation. Minor weld damage was noted on the top assembly between the middle stiffener and the adapter. See Photo 13 for the damage to the weld between the stiffener and the adapter. No significant damage was noted as a result of this test.



**Photo 13. Damage to Weld Between Stiffener and Adapter.**

**3. EDGEWISE ROTATIONAL DROP TEST**. Test Unit #2 was edgewise rotationally dropped from a height of 15 inches on both longitudinal sides and both lateral sides. Minor damage was noted on the welds between the posts and skids and the strut and the bottom of the pallet deck. No significant damage was noted from this test.

**4. INCLINE-IMPACT TEST**. Test Unit #2 was incline-impacted on all four sides with the pallet impacting the stationary wall from a distance of 8 feet. No additional problems were encountered.

**5. FORKLIFTING TEST**. Test Unit #2 was lifted from the end of the pallet on the forks of the forklift truck and carried over the hazard course two times with no damage or instability noted. The test unit was lifted from the opposite end of the pallet and the above steps accomplished with no problems encountered.

**6. SLING COMPATIBILITY TEST**. Test Unit #2 was sling compatibility tested by slinging the container with lifting cables through the lifting rings on the top adapter. No problems were encountered during the lifts.

**7. DISASSEMBLY TEST**. During the disassembly of Test Unit #2 no additional problems were noted.

**8. CONCLUSION**. Test Unit #2 passed all required tests.

**D. TEST RESULTS of TEST UNIT #3:**

**1. STACKING TEST**. Test Unit #3 was compressed with a load force of 12,825 pounds for 60 minutes on 9 August 2004. No damage was noted as a result of this test.

2. **REPETITIVE SHOCK TEST.** Test Unit #3 was vibrated 90 minutes at 205 RPM in the longitudinal orientation and 220 RPM in the lateral orientation. No significant damage was noted as a result of this test.

3. **EDGEWISE ROTATIONAL DROP TEST.** Test Unit #3 was edgewise rotationally dropped from a height of 15 inches on both longitudinal sides and both lateral sides. Minor damage was noted on the welds between the struts and skids and the strut and the bottom of the pallet deck. No significant damage was noted from this test.

4. **INCLINE-IMPACT TEST.** Test Unit #3 was incline-impacted on all four sides with the pallet impacting the stationary wall from a distance of 8 feet. No additional problems were encountered.

5. **FORKLIFTING TEST.** Test Unit #3 was lifted from the end of the pallet on the forks of the forklift truck and carried over the hazard course two times with no damage or instability noted. The test unit was lifted from the opposite end of the pallet and the above steps accomplished with no problems encountered.

6. **SLING COMPATIBILITY TEST.** Test Unit #3 was sling compatibility tested by slinging the container with lifting cables through the lifting rings on the top adapter. No problems were encountered during the lifts.

7. **DISASSEMBLY TEST.** During the disassembly of Test Unit #3 no additional problems were noted.

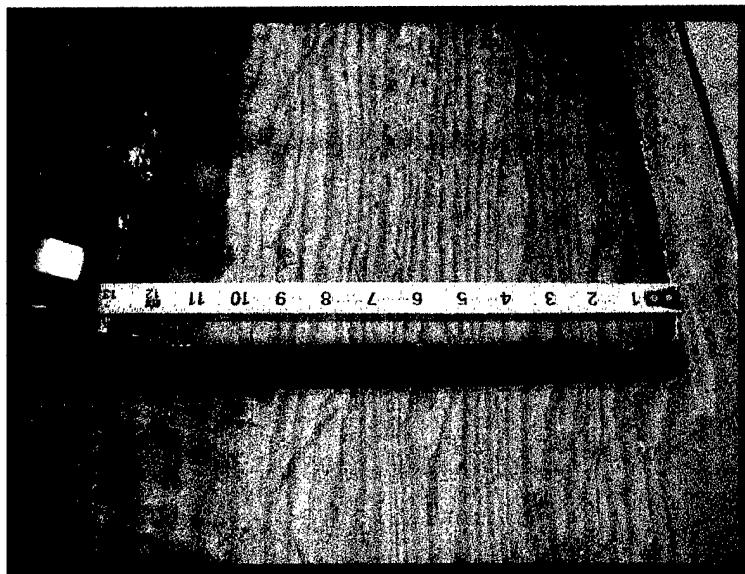
8. **CONCLUSION.** Test Unit #3 passed all required tests.

**E. TEST RESULTS of TEST UNIT #4:**

**STACKING TEST.** Test Unit #4 was compressed with a load force of 12,825 pounds for 60 minutes on 12 August 2004. No damage was noted as a result of this test.

**F. TEST RESULTS of TEST UNIT #5:**

**STACKING TEST.** While loading Test Unit #5, it was discovered that the intermediate adapter had a stiffener aligned incorrectly and the last box could not be loaded. The dimension should have been 13-7/16" from inside to inside to allow the PA125 box to be positioned. The actual dimension was less than 13". See Photo 14 for a picture of the incorrect intermediate adapter dimension. Corrective action was taken by the manufacturer to rework the adapter and testing was completed satisfactorily. Test Unit #5 was compressed with a load force of 12,825 pounds for 60 minutes on 13 August 2004. No damage was noted as a result of this test.



**Photo 14. Intermediate Adapter Wrong Dimension of Test Unit #5.**

**G. TEST RESULTS of TEST UNIT #6:**

**STACKING TEST.** Test Unit #6 was compressed with a load force of 12,825 pounds for 60 minutes on 12 August 2004. No damage was noted as a result of this test.

## **PART 6—DRAWINGS**

The following test sketches represent the load configuration that was subjected to the test criteria.

## APPENDIX 17

# UNITIZATION PROCEDURES FOR AMMUNITION AND COMPONENTS PACKED IN METAL OR PLASTIC BOXES ON 4-WAY ENTRY PALLETS

CARTRIDGE, 25MM, PACKED 30 PER PA125 METAL  
BOX, UNITIZED 42 PER 44" X 40" PALLET;  
APPROX CONTAINER SIZE 14-5/16" L X 5-3/4" W  
X 13-7/8" H

NOTICE: THIS APPENDIX CANNOT STAND  
ALONE BUT MUST BE USED IN CONJUNCTION  
WITH THE BASIC UNITIZATION PROCEDURES  
DRAWING 19-48-4232-20PM1007.

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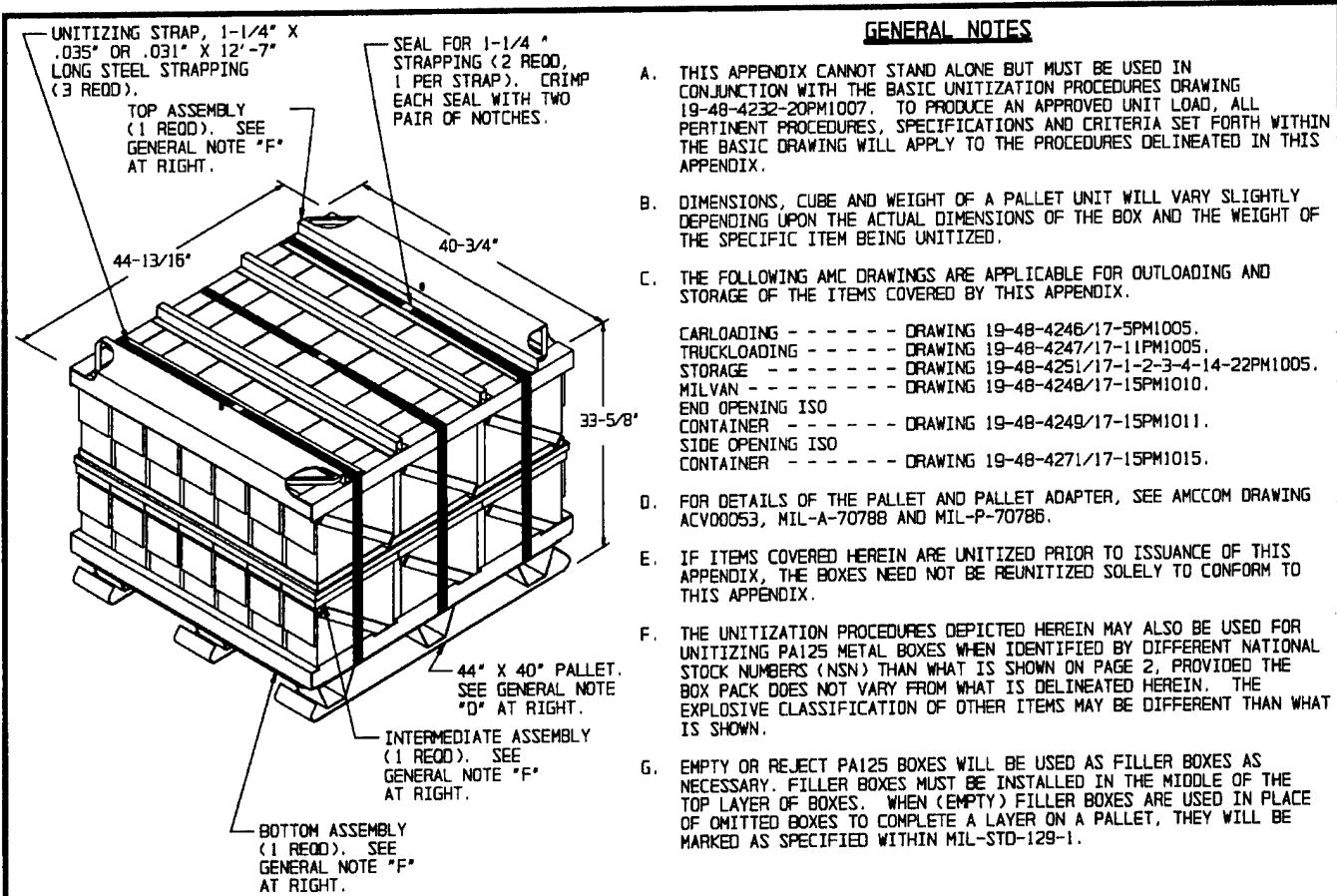
PALLET UNIT DATA				
ITEMS INCLUDED		HAZARD CLASS AND DIVISION		APPROX WEIGHT LBS
NSN	DDODIC	DD CLASS	COMP GROUP	
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01-348-0192	A986	1.2	C	2,467
01-356-0187	A967	---	INERT	2,551
01-356-0188	A975	1.2	E	2,551
01-356-0189	A976	1.2	C	2,551
01-356-9838	A974	1.2	C	2,467

HAZARD CLASSIFICATION DATA CONTAINED IN THE ABOVE CHART IS FOR GUIDANCE AND INFORMATIONAL PURPOSES ONLY. VERIFICATION OF THE SPECIFIED DATA SHOULD BE MADE BY CONSULTING THE MOST RECENT JOINT HAZARD CLASSIFICATION SYSTEM LISTING OR OTHER APPROVED LISTING(S).

#### REVISION

REVISION NO. 1, DATED JUNE 1996, CONSISTS OF, CHANGES PER ECP M6S3023:

1. CHANGING BOX DIMENSIONS AND WEIGHT.
2. ADDING ITEMS BY NATIONAL STOCK NUMBER (NSN) TO "PALLET UNIT DATA" CHART.
3. CHANGING GENERAL NOTES.
4. ADD 3RD STRAP.
5. DELETING GENERAL NOTE RELATING TO STRAP CUTTER AND RE-LETTERING OTHER GENERAL NOTES.



### PALLET UNIT

SEE GENERAL NOTE "B" AT RIGHT.

42 BOXES OF 25MM CTG (30 PER BOX) AT 55 LBS - 2,310 LBS (APPROX)  
 DUNNAGE - - - - - 136 LBS  
 PALLET - - - - - 105 LBS

TOTAL WEIGHT - - - - - 2,551 (APPROX)  
 CUBE - - - - - 35.5 CU FT (APPROX)

### BILL OF MATERIAL

METAL PALLET, 44" X 40" - - -	1 REOD - - - -	105 LBS
TOP ASSEMBLY - - - - -	1 REOD - - - -	80 LBS
INTERMEDIATE ASSEMBLY - - - -	1 REOD - - - -	15 LBS
BOTTOM ASSEMBLY - - - - -	1 REOD - - - -	35 LBS
STEEL STRAPPING, 1-1/4" - - -	37.75' REOD - - -	5.72 LBS
SEAL FOR 1-1/4" STRAPPING - -	3 REOD - - - -	NIL

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